Notice of Interest

This Notice of Interest concerning the release of a Broad Agency Announcement (BAA) for fiscal year 2006 to solicit research and development (R&D) regarding Nuclear Explosion Monitoring Research and Engineering (NEM R&E) is issued in accordance with 10 CFR 600 and 48 CFR Part 35.016. Proposers should not submit a proposal in response to this Notice of Interest, but may submit a proposal after release of a solicitation at a later date. Solicitation Number: DE-SC52-05NA26703.

Description: The Air Force Research Laboratory (AFRL), the National Nuclear Security Administration (NNSA) and the Army Space and Missile Defense Command (SMDC) will be jointly soliciting proposals for R&D to improve national capabilities to detect, locate, and identify nuclear explosions. It is anticipated that this solicitation will be released on or about May 25, 2005 and closed on or about July 26, 2005 seeking proposals with a period of performance of 1-3 years. The objective of the solicitation will be to advance the state-of-the-art in seismic, hydroacoustic, infrasound and radionuclide methods of nuclear explosion monitoring. This will be achieved through basic and applied research that enhances understanding of the underlying phenomena, proposes new methods of tackling monitoring problems, or develops new data of use in nuclear explosion monitoring. Where appropriate, priority will be given to studies of propagation conditions in Eurasia.

Research products developed under this solicitation shall support Air Force's national nuclear explosion monitoring mission requirements for improving the Nation's capabilities to monitor nuclear explosions. Information about the NNSA Nuclear Explosion Monitoring Research & Engineering (NEM R&E) program integration of AFRL, NNSA and SMDC research products into operational form for the Air Force can be found online at https://www.nemre.nnsa.doe.gov/nemre/KnowledgeBase.

Research is being sought in the following topic areas:

TOPIC 1: Challenges in Seismic Monitoring;
TOPIC 2: Calibration and Ground Truth Collection;
TOPIC 3: Velocity Models and Synthetic Seismograms
TOPIC 4: Seismic Detection, Location, Discrimination, and Yield Estimation;
TOPIC 5: Infrasound;
TOPIC 6: Hydroacoustic studies; and
TOPIC 7: Radionuclide studies.

The objective of this solicitation is to enhance U.S. capabilities in nuclear explosion monitoring primarily with ground-based systems. This will be achieved through advances in the state-of-the-art for nuclear explosion monitoring, basic and applied research that enhances understanding of the underlying phenomena, developing new methods of tackling monitoring problems, or developing new data of use in nuclear explosion monitoring. Field experiments may be proposed.

Each of the topic areas is described below. Individual proposals should be directed to only one topic area, but the Proposer may submit proposals in more than one topic area. All topic areas are of importance. However, depending on the proposals received and programmatic needs, funding will not necessarily be distributed evenly among the topic areas.

Topic 1 (Challenges in Seismic Monitoring)

Proposals are sought that address the characteristics of small seismic events and the associated seismic signals observed at local (< 200 km) and regional (< 2000 km) distances. Of particular interest are methods of estimating yield (or equivalent) with uncertainties of a factor of 10 or less for seismic events recorded at local distances (where, for instance, coda may not be available as a stable estimator). The properties of small near surface events are of particular interest, including the variability in local and regional discriminant properties of point explosions, distributed explosions, mine-related stress release, mining activities, shallow earthquakes, and cavity-decoupled explosions; the variation in these discriminant properties with event size over five orders of magnitude; and the variability in and nature of propagation of phases from such events at local distances. Characterization of factors such as tectonic setting or other regional characteristics that affect or determine the characteristics of microseismicity in different locales is also of interest. Systematic studies of all the factors, or as many as practicable, in one or more regions, with delivery of database(s) with appropriate metadata, are desirable. Development of new rugged sensors suitable for portable deployment with observation of the full suite of signals pertinent for local and regional distances is of interest. Proposals are sought on the generation of S waves by decoupled or partially coupled events relative to tamped events. Combined interpretation of seismic and infrasound signals should be submitted under Topic 5.

Topic 2 (Seismic Calibration and Ground Truth Collection)

Proposals to find events that can be used to calibrate seismic monitoring are sought. For location calibration, proposals for dedicated GT0 calibration explosions are of high interest, especially reciprocal calibration shots. Collection of location ground truth at a GT5 level (absolute location and depth errors less than 5 kilometers) or better is sought for events of magnitude 2.5 and larger. Appropriate techniques might include: a) dense local networks, b) instrumented mines, and c) remote sensing. Proposals must specifically address uncertainties in the acquired ground truth information, either by using accepted standards or by proposing credible new methods; research efforts on new methods of acquiring location ground truth will be accepted under this topic.

Geophysical studies that generate new discrimination ground truth events with source geometry and other characterizing information are sought, such as shallow earthquakes, mining explosions or mining related studies. Calibration of regional coda magnitudes is of interest. Proposals are also sought that characterize transition zone propagation, i.e. mapping and calibrating travel time and amplitude behavior of P and S waves traveling through the transition zone (ray bottoming depths from the Moho to 660 km, and distance ranges from 13 to 30 degrees).

Proposals for development of methods to transfer existing geophysical calibration information (e.g., travel-times, attenuation, etc.) from open seismic stations to new or planned stations and arrays in the monitoring network are of interest. Proposals are sought to estimate geological and geophysical constraints on explosion emplacement conditions in complex areas, especially highly variable regions.

Topic 3 (Velocity Models and Synthetic Seismograms)

Proposals are sought to develop models that calibrate earth velocity and attenuation structure, especially in aseismic regions. As part of this topic there is an interest in new techniques of determining velocity models, such as: tomography; procedures that develop models by fitting multiple datasets; procedures that estimate the uncertainty of geophysical models and tradeoffs between different parameters of these models, and the resulting uncertainty in observables such as travel times and amplitudes; and studies comparing different methods to find the strengths and weaknesses of each. Improved Q models with emphasis on regional phases Pn, Pg, Sn, Lg and surface waves are desirable. Priority will be given to studies of propagation conditions in Eurasia.

Innovative methods of computing synthetic seismograms for local, regional, and near teleseismic distances are of interest. Some topics of interest are 3D computations in large models, more efficient 2.5D calculations that could be incorporated in other routines (e.g., location), hybrid or approximate methods that have significant advantages over other methods, and methods that calculate spectra or envelopes; or other relevant topics.

Topic 4 (Seismic Detection, Location, Discrimination, and Yield Estimation)

Research proposals to improve seismic detection, location, discrimination, and yield estimation for nuclear explosion monitoring are sought, as detailed below. Tuning studies, either of specific arrays or of techniques in general, are not sought.

New and innovative seismic signal processing methods are sought with potential to significantly lower the thresholds at which detection, location and identification functions can be performed at acceptable false alarm rates. Methods from other areas of seismology such as volcano monitoring could be considered. New and innovative methods of array signal processing are solicited that employ calibration or other techniques to enhance signal detection and parameter estimation (e.g., azimuth, phase velocity) in strongly heterogeneous media. Full waveform methods, including waveform matching, for seismic event detection, location, and discrimination are of particular interest, especially studies that assess success and failure rates and the effect of less than perfect matching. Estimating improvements in detection, including testing of detection processes using superposition of actual signals in increasing noise, is of interest.

Improved methods of arrival-time picking and phase identification, especially for local (0-200 km) and far-regional (1500 km and greater) phases are desired. Improved location techniques are sought; especially development and validation of mathematical and geophysical techniques for determining new ground truth events and earth structure. An example could be combining relative event locations with limited ground truth constraints (such as fault traces).

Proposals for advanced discrimination methods that make significant improvement over current techniques would be of interest, as are new techniques of detecting and validating depth phases for crustal events observed locally, regionally and teleseismically. Proposals to extend existing techniques of discrimination such as Ms:mb to lower level regional signals are of particular interest, as are other possible discriminants using intermediate period data. The influence of source processes on observed seismic data is of interest, as detailed below.

Proposals are sought complementing existing efforts to answer the question of how seismic energy is generated from underground phenomena (including distributed and single point explosions, double-couple earthquakes and other modes of rock failure), how this energy is partitioned between P and S waves, and how it propagates to local (less

than 200 km) and regional distances (less than 2,000 km). Generation of S waves from explosions is of interest, as are models of the source, both theoretical and empirical. Also of interest are observational and experimental studies of small shallow earthquakes, especially high stress drop events, such as in mines. In propagation, the influence of 3D laterally varying structure, including laterally varying vertical velocity gradients, and 3D scattering on the stability of propagation of Pn, Pg, Sn, Lg is of interest. New methods of estimating the yield of a fully coupled explosion, and how emplacement conditions affect the observation, e.g., frozen hard rock, are of interest. Proposals for theoretical and observational investigations, including empirical source models and mine investigations will be accepted under this topic.

Topic 5 (Infrasound)

Proposals are sought for an improved understanding of the fundamental physics of generation of infrasound from underground contained and near-surface explosions and other sources, of local and regional propagation of infrasound signals from such sources, and of atmosphere dynamics affecting propagation of such signals.

Proposals are sought on the interpretation of signals from co-located infrasound and seismic sensors at local and regional distances (data from separated infrasound and seismic sensors could be used to understand phenomenology observed at collocated sensors). Phase association, yield estimation and event identification are of particular interest. Infrasound propagation and atmospheric effects on local and regional travel and arrival times are of interest. Explosive events of known origin to allow correlation and calibration of infrasound and seismic sensors at local and regional distances are of interest.

Other topics include the uncertainty in azimuth and range determinations for infrasound signals from seismic events at local and regional distances; and the maximum infrasound signal expected from an event that does not have a surface component of energy release. In addition, proposals are sought on causes of observed local and regional time errors for ground-truth events including a better understanding of the physical processes which result in a loss of infrasonic signal coherence from source to receiver.

Proposals are sought for new infrasound sensors that have potential for low cost, low intrinsic noise, low susceptibility to wind noise, and ruggedness. Sensors with embedded logic, digitization and communications ability are especially attractive.

Topic 6 (Hydroacoustic for Discrimination of Underwater Seismic Events)

Proposals are sought that investigate the physics of long-range hydroacoustic propagation of high-frequency (>30 Hz) energy through the Antarctic convergence zone, by hydroacoustic coastline reflection, and through and around blockages. Observational, experimental, and theoretical studies are of interest; studies that combine data with theory are of particular interest for potential discrimination of underwater seismic events.

Topic 7 (Radionuclide)

Proposals are sought to enhance the United State's ability to monitor foreign nuclear tests through improved instrumentation used for the detection of radioactive particulates and xenon and processes/methods that facilitate improved data discrimination.

For improved radio-xenon monitoring, areas of research involving instrumentation that are of interest include high stability pressure transducers, gas analyzers, and beta detectors. Of particular interest are proposals that use simple,

innovative techniques to achieve high accuracy and stability in field-condition measurement systems, and that have low production costs. Research that would result in sensors that can be used for 6 months or more without re-calibration and have a jitter of less than ±0.1% are desired. For gas analyzers, the equipment must also have the ability to measure xenon in a variety of other gases with little or no data analysis necessary and no manual intervention. Also for radioactive xenon monitoring, novel techniques to collect xenon are sought. Examples are permselective membranes, high capacity room temperature adsorbents, or other techniques that minimize complexity, power usage, and costs.

For improved radioactive particulate monitoring, areas of research involving instrumentation that are of interest include novel concepts that produce more reliable germanium detector operation in field situations than afforded by today's commercial mechanical cooling systems. Systems should be able to run continuously without manual intervention for as long as possible, and at least 6 months. The cooling system should be capable of cooling large germanium crystals to operating temperatures without complex machinery. Also of interest for particulate monitoring are inlet systems suitable for use on particulate samplers such as the Radionuclide Aerosol Sampler/Analyzer that could operate effectively in high winds or in icing conditions as observed in Antarctic locations.

Possible topics in the area of data discrimination might include methods to improve the quantification and identification of radionuclides in the presence of high natural backgrounds; precise identification of source locations and emission mechanisms. Additional topics could include methods to correlate specific radionuclides based upon ground system measurements.

**********END OF TOPICS**********

After the solicitation is released, proposals may be submitted for either a contract or a financial assistance award. However, AFRL, NNSA and SMDC reserve the right to determine which procurement instrument shall be used. The instrument shall be appropriate to the scope of work and performing organization. NNSA may issue contracts or financial assistance awards, or both. The Air Force and Army will issue contracts only. If a contract is issued, acquisition regulations apply per 48 CFR, and a cost reimbursement contract is anticipated. If a financial assistance award is used, 10 CFR 600 applies, and a cooperative agreement is anticipated.

The BAA will solicit proposals from all responsible organizations (foreign and domestic) including industry, academic institutions, research institutions, and non-profit organizations. Federal agencies may submit proposals as prime/lead contractors subject to appropriations language but may not partner with Federally Funded Research and Development Centers (FFRDC). FFRDCs, including NNSA national laboratories, cannot directly respond to this solicitation as prime/lead participants. FFRDCs, including NNSA national laboratories, may participate in this solicitation as team members; however, such participation must be consistent with the FFRDCs sponsoring agreement. The FFRDC effort for any proposal, in aggregate, shall not exceed 50% of the total effort of the project. Information will be provided in the solicitation on how to include FFRDCs such as NNSA national laboratories in this solicitation as team members.

Teaming is encouraged. Teaming that results in facilitating integration of research products into the NNSA Knowledge Base will enhance programmatic value. Teaming that results in training of graduate students (in particular university/industry teams as a way of providing real world problems for Ph.D. candidates to work on) will enhance

programmatic value. Programmatic value is one of the selection criteria for proposals. If teaming arrangements are proposed, technical approach, deliverables and costs must be clearly separable for individual team members as the Government reserves the right to award to the team or to individual team members.

The NNSA, AFRL and SMDC each reserve the right to fund, in whole or in part, any, all or none of the proposals and to award without discussions. All awards will have an NNSA Product Integrator (subject matter expert) assigned at the time of award to help ensure maximum value to the US Government of research products successfully transitioning to operations as appropriate.

This Notice of Interest is being issued in advance of passage of fiscal year 2006 appropriations to provide more time for potential proposers to prepare and to allow awards to be made as early as possible within the 2006 fiscal year. The topics in this Notice of Interest represent the maximum set of topics that may appear in the solicitation. The final number of topics and awards, however, are subject to the availability of funds.

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Contracting Office Address

U.S. Dept. of Energy
NNSA Service Center, AD
P.O. Box 5400, Albuquerque, NM 87185
Email your questions to Mr. Robert D. Lowther, Contract Specialist
(505) 845-6839 (phone); (505) 845-5181 (fax)
rlowther@doeal.gov (email)

Requiring Activity: The Air Force Research Laboratory (AFRL), the Army Space and Missile Defense Command (SMDC), and the National Nuclear Security Administration (NNSA). Classification Code: A NAICS Code: 541710